REMARKS

In view of the above amendments and the following remarks, reconsideration of the rejections contained in the Office Action of August 31, 2006 is respectfully requested.

The specification and abstract have now been amended as indicated above so as to make various editorial corrections. In particular, the changes on page 21 of the specification have been made so as to provide consistency between this section of the specification and the remaining disclosure (see, for example, page 27, lines 5-9 and 20-24). Because these changes are merely formal in nature, no new matter has been added by these amendments. Therefore, the Examiner is respectfully requested to enter the formal amendments to the specification as indicated above.

The Examiner rejected elected claims 1-16 in view of the prior art. In particular, the Examiner rejected independent claim 1 and dependent claims 2-5 and 7-8 as being unpatentable over the Chen reference (U.S. Publication 2002/0130049) in view of the Kimura reference (U.S. Publication 2001/0024691); rejected dependent claim 6 as being unpatentable over the Chen reference in view of the Kimura reference, and further in view of the Matsuda reference (USP 6,375,823); rejected independent claim 9 and dependent claims 10-13 and 15-16 as being unpatentable over the Chen reference in view of the Kimura reference, and further in view of the Talieh reference (USP 6,176,992); and rejected dependent claim 14 as being unpatentable over the Chen reference in view of the Kimura reference and the Talieh reference, and further in view of the Matsuda reference. However, independent claims 1 and 9 have been amended as indicated above so as to further clarify the distinctions between the present invention and the prior art. For the reasons discussed below, it is respectfully submitted that the amended claims are clearly patentable over the prior art of record.

The present invention is directed to an electrolytic processing apparatus that is capable of forming fine interconnection patterns in a semiconductor substrate. In particular, as recited in amended independent claims 1 and 9, the apparatus comprises a relative movement mechanism for moving a substrate holder and an electrode head relative to each other such that, during electroplating of the processing surface of the substrate, the substrate holder and the electrode head are arranged to provide a space between the processing surface of the substrate and the polishing surface, and such that, during electrolytic etching of the processing surface of the

substrate, the substrate holder and the electrode head are arranged so that the polishing surface rubs the processing surface of the substrate. The electrolytic processing apparatus further comprises *a power source for applying a voltage between a first electrode arranged to make contact with a substrate held by a substrate holder and a second electrode of an electrode head.* The power source is capable of selectively switching the direction of electric current such that, during electroplating of the processing surface of the substrate, *the first electrode serves as a cathode and the second electrode serves as an anode*, and such that, during electrolytic etching of the processing surface of the substrate, *the first electrode serves as an anode and the second electrode serves as a cathode*. (See page 25, lines 1-5 and page 27, lines 5-28 of the original specification). As a result of this arrangement, the apparatus can alternate between electroplating and electrolytic etching to thereby selectively etch away raised portions of a plated film so as to improve the flatness of the plated film even if both fine grooves and large grooves are present in the surface of the substrate (see page 4, lines 13-21 of the original specification).

The Chen reference discloses a method and apparatus for planarizing a substrate. The Examiner asserted that the Chen reference teaches a first electrode 802 to make contact with the substrate for passing electricity to a processing surface of the substrate, and a second electrode 426 and a polishing surface 428 facing the processing surface of the substrate 422 held by a substrate holder 478.

As explained in paragraphs [0097] and [0098] on page 8 of the Chen reference, and as illustrated in Figure 8, the "first electrode" (contact plate) 802 is located within a recess in the support plate 804 of the substrate carrier head assembly 800, and is arranged to contact a surface of the substrate 422. As explained in the last sentence of paragraph [0097], a terminal 810 shown in Figure 8 couples the contact plate 802 "to a power source (not shown) by a lead 808 that is used to bias the substrate 422." On the other hand, the "second electrode" (anode/cathode) 426 is illustrated in Figure 4 and described in paragraph [0069] of the Chen reference. In particular, the anode/cathode 426 is located within the partial enclosure 434 beneath the "polishing surface" (permeable disk) 428. During removal of material from the substrate (i.e., an etching process), for example, "the anode/cathode 426 functions as a cathode and the wafer

surface or permeable disk 428 may act as an anode for the dissolution process." (See last sentence of paragraph [0069]).

Although the Examiner has asserted that the first electrode corresponds to the contact plate 802 while the second electrode corresponds to the anode/cathode 426, the Chen reference does not disclose or suggest a power source for applying a voltage *between the "first electrode" 802 and the "second electrode" 426*. In particular, the Chen reference does not even suggest that the power source coupled to the contact plate 802 is the same power source which provides electrical current to the anode/cathode 426 such that the power source applies a voltage between the "first electrode" 802 and the "second electrode" 426. Moreover, as noted above with respect to paragraph [0069], during removal of material from the substrate surface (i.e., electrolytic etching), the "second electrode" (anode/cathode) 426 functions as a cathode while the permeable 428 or wafer surface acts as the anode. In other words, the Chen reference does not teach or even suggest that the "first electrode" 802 (as identified by the Examiner) is connected to a power source capable of switching the direction of electric current so that the first electrode (contact plate) 802 can selectively serve as an anode or a cathode. Therefore, the Chen does not disclose or suggest a power source capable of selectively switching the direction of electric current such that, during electroplating of a processing surface of a substrate, a first electrode serves as a cathode and a second electrode serves as an anode, and such that, during electrolytic etching of the processing surface of the substrate, the first electrode serves as an anode while the second electrode serves as a cathode, as now recited in amended independent claims 1 and 9.

In addition, the Chen reference teaches a lift mechanism 486 which controls the elevation of the carrier assembly in relation to the partial enclosure 434 (see paragraph [0066]). However, the Chen reference does not teach or suggest a relative movement mechanism for moving the substrate holder and the electrode head relative to each other such that, during electroplating of the processing surface of the substrate, the substrate holder and the electrode head *are arranged to provide a space between the processing surface of the substrate and the polishing surface*, and such that, during electrolytic etching of the processing surface of the substrate, the substrate holder and the electrode head are arranged so that the polishing surface rubs the processing surface of the substrate.

The Kimura reference, the Matsuda reference and the Talieh reference also do not disclose or suggest a first electrode, a second electrode, a relative movement mechanism, and a power source as recited in amended independent claims 1 and 9. Therefore, one of ordinary skill in the art would not be motivated by these references to modify the Chen reference so as to obtain the invention recited in amended independent claims 1 and 9. Accordingly, it is respectfully submitted that amended independent claims 1 and 9, and the claims that depend therefrom, are clearly patentable over the prior art of record.

The Examiner's attention is also directed to new dependent claims 28-30, which recite features that are not even suggested in the combination of prior art references applied by the Examiner. Therefore, in addition to the reasons discussed above with respect to amended independent claims 1 and 9, it is respectfully submitted that dependent claims 28-30 are further patentable over the prior art of record.

In view of the above amendments and remarks, it is submitted that the present application is now in condition for allowance. However, if the Examiner should have any comments or suggestions to help speed the prosecution of this application, the Examiner is requested to contact the Applicant's undersigned representative.

Respectfully submitted,

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Version with Markings to Show Changes Made

ABSTRACT OF THE DISCLOSURE

~~There is provided an electrolytic processing apparatus and method that can improve the flatness of a plated film on a substrate even when fine grooves and large grooves are co-present in the surface of the substrate, enabling a later CMP processing to be carried out in a short time while preventing dishing during the CMP processing.~~

An electrolytic processing apparatus according to an embodiment of the present invention includes: a substrate holder for holding a substrate; a first electrode to make contact with the substrate for passing electricity to a processing surface of the substrate; an electrode head including a high resistance structure and a second electrode, disposed opposite to and in this order from the substrate holder, and a polishing surface facing the processing surface of the substrate held by the substrate holder; an electrolytic solution injection portion for injecting an electrolytic solution between the processing surface of the substrate held by the substrate holder and the second electrode; a relative movement mechanism for moving the substrate holder and the electrode head relative to each other; a press mechanism for pressing the polishing surface of the electrode head against the substrate held by the substrate holder; and a power source for applying a voltage between the first electrode and the second electrode~~,~~ . ~~the~~ The power source ~~being~~ is capable of selectively switching the direction of electric current.